CITY OF MACKAY (PWS 7190032)
SOURCE WATER ASSESSMENT FINAL REPORT

April 18, 2003

State of Idaho
Department of Environmental Quality

Executive Summary

Under the Safe Drinking Water Act Amendments of 1996, all states are required by the U.S. Environmental Protection Agency (EPA) to assess every source of public drinking water for its relative sensitivity to contaminants regulated by the Act. This assessment is based on a land use inventory of the designated source water assessment area and sensitivity factors associated with the well and aquifer characteristics.

This report, *City of Mackay, Idaho, Source Water Assessment Report* describes the public drinking water system (PWS), the boundaries of the zones of water contribution, and the associated potential contaminant sources located within these boundaries. This assessment should be used as a planning tool, taken into account with local knowledge and concerns, to develop and implement appropriate protection measures for this source. **The results should not be used as an absolute measure of risk and they should not be used to undermine public confidence in the water system.**

Final well water susceptibility scores are derived from equally weighting potential contaminant inventory/land use scores, hydrologic sensitivity scores, and system construction scores. Final spring water susceptibility scores are derived from heavily weighting potential contaminant inventory/land use scores and adding them with system construction scores. Therefore, a low rating in one category coupled with a higher rating in the another category results in a final rating of low, moderate, or high susceptibility. Potential contaminants are divided into four categories: inorganic chemical (IOC) contaminants (e.g., nitrates, arsenic), volatile organic chemical (VOC) contaminants (e.g., petroleum products), synthetic organic chemical (SOC) contaminants (e.g., pesticides), and microbial contaminants (e.g., bacteria). As a well or spring can be subject to various contamination settings, separate scores are given for each type of contaminant.

The City of Mackay drinking water system consists of two well sources and a spring source. Well #1 has a moderate susceptibility to all potential contaminant categories: IOCs, VOCs, SOCs, and microbial contaminants. Well #2 has a high susceptibility to microbial contaminants and a moderate susceptibility to IOCs, VOCs, and SOCs. The City Spring has a low susceptibility to all potential contaminant categories. The predominant irrigated agricultural land around the wells contributed to the overall susceptibility of both wells. The poor to moderately drained soils of the area and the limited number of contaminant sources within the delineations reduced the final susceptibility scores. The high microbial susceptibility of Well #2 is due to a larger number of potential contaminant sources in the 3-year time-of-travel (TOT) zone that can potentially add microbial contaminants to the water source.

No VOCs or SOCs have been recorded for the wells or the spring during any water chemistry tests. Total coliform bacteria were periodically detected in the distribution system between August 1995 and July 1999. However, no coliform bacteria have been detected at the wells or the spring. The IOCs barium, cadmium, chromium, copper, fluoride, lead, and nitrate were detected in the system at levels below the maximum contaminant level (MCL). Arsenic was detected in Well #2 and at the spring at 5 parts per billion (ppb) in December 1995, a level one-half of the recently revised MCL of 10 ppb. In October 2001, the EPA lowered the arsenic standard from 50 ppb to 10 ppb, giving public water systems until 2006 to comply with the new standard. EPA requires reporting to the Consumer Confidence Report (CCR) if concentrations of detected compounds are greater than half their MCL. Further information and health side effects can be researched at http://www.epa.gov/safewater/ccr1.html.

This assessment should be used as a basis for determining appropriate new protection measures or re-evaluating existing protection efforts. No matter what ranking a source receives, protection is always important. Whether the source is currently located in a "pristine" area or an area with numerous industrial and/or agricultural land uses that require surveillance, the way to ensure good water quality in the future is to act now to protect valuable water supply resources. If the system should need to expand in the future, new well sites should be located in areas with as few potential sources of contamination as possible, and the site should be reserved and protected for this specific use.

For the City of Mackay, drinking water protection activities should focus on correcting any deficiencies outlined in the sanitary survey (an inspection conducted every five years with the purpose of determining the physical condition of a water system's components and its capacity). Also, disinfection practices should be implemented if microbial contamination becomes a problem. No chemicals should be stored or applied within the 50-foot radius of the wellheads and the 100-foot radius of the spring source. Additionally, there should be a focus on the implementation of practices aimed at reducing the leaching of farm chemicals from agricultural land within the designated source water areas and awareness of the potential contaminant sources within the delineation zones. Since much of the designated protection areas are outside the direct jurisdiction of the City of Mackay, collaboration and partnerships with state and local agencies, and industry groups should be established and are critical to the success of drinking water protection.

Due to the time involved with the movement of ground water, drinking water protection activities should be aimed at long-term management strategies even though these strategies may not yield results in the near term. A strong public education program should be a primary focus of any drinking water protection plan as the delineations are near urban and residential land uses. Public education topics could include proper lawn and garden care practices, household hazardous waste disposal methods, proper care and maintenance of septic systems, and the importance of water conservation to name but a few. There are multiple resources available to help communities implement protection programs, including the Drinking Water Academy of the EPA. As there is a transportation corridor (Highway 93) through the delineations of the wells, the Idaho department of transportation should be involved in protection activities. Drinking water protection activities for agriculture should be coordinated with the Idaho State Department of Agriculture, the Soil Conservation Commission, the Custer Soil and Water Conservation District, and the Natural Resources Conservation Service.

A community must incorporate a variety of strategies in order to develop a comprehensive drinking water protection plan, be they regulatory in nature (e.g. zoning, permitting) or non-regulatory in nature (e.g. good housekeeping, public education, specific best management practices). For assistance in developing protection strategies please contact the Idaho Falls Regional Office of the Idaho Department of Environmental Quality or the Idaho Rural Water Association.

SOURCE WATER ASSESSMENT FOR THE CITY OF MACKAY, IDAHO

Section 1. Introduction - Basis for Assessment

The following sections contain information necessary to understand how and why this assessment was conducted. **It is important to review this information to understand what the ranking of this assessment means.** Maps showing the delineated source water assessment area and the inventory of significant potential sources of contamination identified within that area are attached. The list of significant potential contaminant source categories and their rankings used to develop the assessment is also included.

Background

Under the Safe Drinking Water Act Amendments of 1996, all states are required by the EPA to assess every source of public drinking water for its relative susceptibility to contaminants regulated by the Safe Drinking Water Act. This assessment is based on a land use inventory of the delineated assessment area and sensitivity factors associated with the wells and aquifer characteristics.

Level of Accuracy and Purpose of the Assessment

Since there are over 2,900 public water sources in Idaho, there is limited time and resources to accomplish the assessments. All assessments must be completed by May of 2003. An in-depth, site-specific investigation of each significant potential source of contamination is not possible. **Therefore, this assessment should be used as a planning tool, taken into account with local knowledge and concerns, to develop and implement appropriate protection measures for this source. The results should <u>not be</u> used as an absolute measure of risk and they should <u>not be</u> used to undermine public confidence in the water system.**

The ultimate goal of the assessment is to provide data to local communities to develop a protection strategy for their drinking water supply system. The Idaho Department of Environmental Quality (DEQ) recognizes that pollution prevention activities generally require less time and money to implement than treatment of a public water supply system once it has been contaminated. DEQ encourages communities to balance resource protection with economic growth and development. The decision as to the amount and types of information necessary to develop a drinking water protection program should be determined by the local community based on its own needs and limitations. Wellhead or drinking water protection is one facet of a comprehensive growth plan, and it can complement ongoing local planning efforts.

Section 2. Conducting the Assessment

General Description of the Source Water Quality

The public drinking water system for the City of Mackay is comprised of two ground water wells and a spring that serve approximately 650 people through 370 connections for community use. Situated in Custer County, the wells are located within the center of town near the parks approximately 2 blocks southwest of Highway 93 and the spring is located approximately one-half mile southwest of the city limits between Taylor Canyon and Rio Grande Canyon (Figure 1).

There are no current significant potential water problems affecting the City of Mackay. Total coliform bacteria have been periodically detected in the well distribution system between August 1995 and July 1999. However, no coliform bacteria have been detected at either of the wellheads. The IOCs barium, copper, fluoride, lead, chromium, and nitrate were detected in the system at levels below the MCLs. Arsenic was detected in Well #2 and at the spring at 5 parts per billion (ppb) in December 1995, a level one-half of the recently revised MCL of 10 ppb. In October 2001, the EPA lowered the arsenic standard from 50 ppb to 10 ppb, giving public water systems until 2006 to comply with the new standard. EPA requires reporting to the Consumer Confidence Report (CCR) if concentrations of detected compounds are greater than half their MCL. Further information and health side-effects can be researched at http://www.epa.gov/safewater/ccr1.html. No VOCs or SOCs have been detected in the wells or the spring during any water chemistry tests.

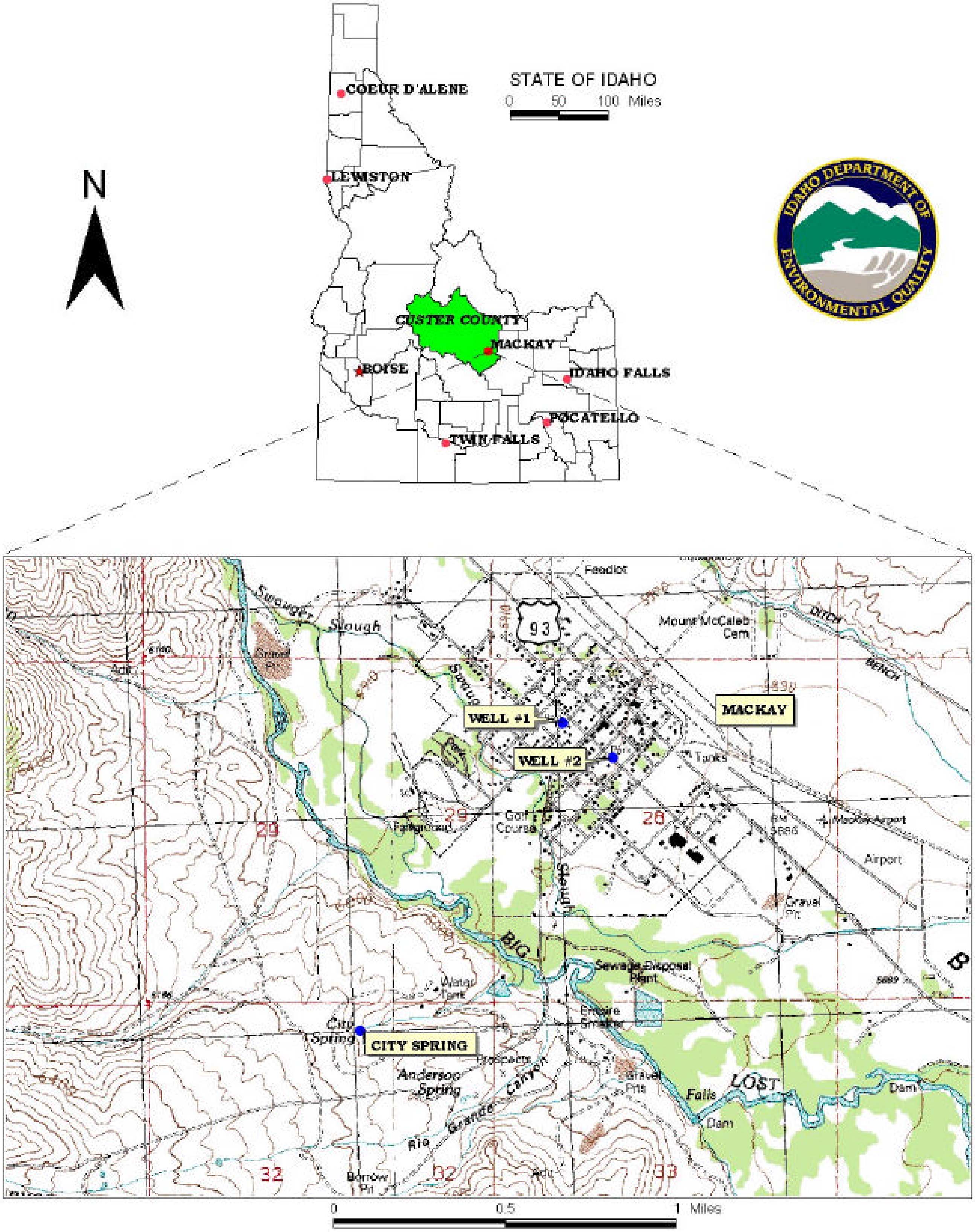
Defining the Zones of Contribution – Delineation

The delineation process establishes the physical area around a well or spring that will become the focal point of the assessment. The process includes mapping the boundaries of the zone of contribution into time-of-travel (TOT) zones (zones indicating the number of years necessary for a particle of water to reach a well) for water in the aquifer. DEQ contracted with Washington Group, International (WGI) to perform the delineations using a refined computer model approved by the EPA in determining the 3-year (Zone 1B), 6-year (Zone 2), and 10-year (Zone 3) TOT zones for water associated with the Big Lost River aquifer (the wells) and the None hydrologic province (the spring) in the vicinity of the City of Mackay. The computer model used site specific data, assimilated by WGI from a variety of sources including the City of Mackay operator input, local area well logs, and hydrogeologic reports (detailed below).

Big Lost River Hydrogeologic Conceptual Model

The Big Lost River basin occupies approximately 1,400 square miles at the northern side of the Eastern Snake River Plain (Szczepanowski, 1982). The basin is northwest to southeast trending and is bounded on the east by the Lost River Range and on the west by the White Knob Mountains. The adjacent mountains are composed of a sedimentary sequence of limestone, dolomite, quartzite, sandstone, shale, and argillite. Granitic rock occurs in some places within the sedimentary units, while volcanic materials cover an extensive area at higher elevations. Basalt from the Snake River Plain is also found at the surface in the south end of the Big Lost River basin.

FIGURE 1. Geographic Location of the City of Mackay



The Big Lost River flows through the axis of the valley and is controlled by the Mackay Dam. An examination of the historical stream flow data (USGS, 2000a) indicates that base flow of the river near Mackay is relatively constant during the year, except during the summer months when the flow rate is increased. It is believed that the Big Lost River stage controls the regional ground-water levels. Flow in the Sharp Ditch (USGS, 2000b) along the eastern edge of the foothills is intermittent and occurs only in the summer months when irrigation demand is high.

The valley-fill sediments are present in two forms: cemented and unconsolidated. Calcite cement binds together fragments of sandstone, quartzite, and limestone of the old colluvial fans. The unconsolidated materials are composed of clay- to boulder-size particles and range greatly in degree of sorting. The alluvial fill varies from 2,000 to 3,000 feet thick in the Barton Flat area to over 5,000 feet east of Mackay (Szczepanowski, 1982, p. 5).

The primary source of water to the alluvial aquifer is precipitation at higher elevations that infiltrates through fractures in the bedrock. Some of the water is discharged to streams, and some continues downslope entering the valley alluvium. Numerous streams lose all their flow to the highly permeable colluvial fans found near the valley floor. Other sources of recharge include precipitation on the valley floor, irrigation, and leakage from canals. Annual precipitation within the basin is elevation-dependent and varies from 10 to 45 inches (Szczepanowski, 1982, p. 3).

Natural discharge of ground water occurs as gains to the Big Lost River, as underflow leaving the basin south of Arco, and as evapotranspiration where the water table is at or near the land surface.

The water table ranges in elevation from about 6,300 feet above mean sea level (ft msl) near Chilly to 5,200 ft msl south of Arco (Briar et al., 1996). Ground water flow direction generally follows the valley centerline toward the south and southeast. The valley fill aquifer generally is unconfined, although perched and artesian conditions are known to occur. Localized perched and artesian zones developed as the result of widely scattered lenses of low-permeability materials (Szczepanowski, 1982, p. 6).

None Hydrogeologic Conceptual Model

Graham and Campbell (1981) identified and described 70 regional ground water systems throughout Idaho. Thirty-four of these fall within the southeastern part of the state. The “None” hydrologic province, as defined in this report, includes all the area outside of the 34 regional systems in southeast Idaho. The smaller and more localized aquifers in the “None” province typically are situated in the foothills and mountains that surround and recharge the regional ground water systems.

The mountains and valleys within the “None” hydrologic province were formed during two events separated by approximately 50 to 70 million years (Alt and Hyndman, 1989, pp. 329 and 336). The overthrust belt of the northern Rocky Mountains was formed roughly 70 to 90 million years ago through the intrusion of granitic magma and a massive eastward movement of large slabs of layered sedimentary rocks along faults that dip shallowly westward (Alt and Hyndman, 1989, p. 329). This movement caused extreme folding and fracturing of the sedimentary and granitic rocks and, in many cases, left older formations lying on top of younger ones. Later Basin and Range block faulting broke up the largely eroded Rocky Mountains into large uplifted and downthrown blocks resulting in the present day northwest trending mountains and valleys seen throughout southeast Idaho. Paleozoic and Precambrian limestone, dolomite, sandstone, shale, siltstone, and quartzite are the predominant materials forming the mountains and probably compose the bedrock underlying the valleys between Salmon, Idaho on the north side of the Snake River Plain and Franklin, Idaho near the Utah/Idaho border (Dion, 1969, p.18; Kariya et al., 1994, p. 6; Bjorklund and McGreevy, 1971, p. 12; and Parliman, 1982, p. 9).

Ground water movement in the mountains is primarily through a system of solution channels, fractures and joints that commonly transmit water independently of surface topography (Bjorklund and McGreevy, 1971, p. 15; Dion, 1969, p. 18). Ralston and others (1979, pp. 128-129) state that the geologic structural features also can contribute to the development of cross-basin ground water flow systems. Ground water entering a geologic formation tends to follow the formation because hydraulic conductivities are greater parallel to the bedding planes than across them. Synclines and anticlines provide structural avenues for ground water flow under ridges from one valley to another.

Precipitation and seepage from streams are the primary source of recharge to the mountain aquifers (Kariya, et al., 1994, p. 18, and Parliman, 1982, p. 13). Ground water discharge occurs as springs and seeps issuing from faults, fractures, and solution channels and as underflow to regional aquifers.

There is little available information on the distribution of hydraulic head and the hydraulic properties of the aquifers in the “None” hydrologic province. No U.S. Geological Survey (2001) or Idaho Statewide Monitoring Network (Neely, 2001) wells are located in the areas of concern to provide information on ground water flow direction and hydraulic gradient or to aid in model calibration. The information that is available indicates that the hydraulic properties are quite variable, even within a specific rock type. Ralston and others (1979, p. 31), for example, present hydraulic conductivity estimates for fractured chert ranging from 2.2 to 75 feet per day (ft/day). Estimates for phosphatic shale are as low as 0.07 ft/day (unfractured) and as high as 25 ft/day (fractured).

Well Delineation Method

The analytic element model WhAEM2000 (Kraemer et al., 2000) was used to delineate the 3-, 6-, and 10-year capture zones for PWS wells located within the Big Lost River Valley hydrologic province.

Lithologic logs of Wells #1 and #2 indicate that the aquifer is unconfined with sand, gravel, and a mixture of sand, gravel, and clay. The Idaho Wellhead Protection Plan (IDEQ, 1997, Appendix A) presents transmissivity estimates of 47,100 ft^2/day for Well #1 and 48,700 ft^2/day for Well #2, based on analysis of specific capacity data. The equivalent hydraulic conductivities are 725 and 812 ft/day, respectively, conservatively assuming that the aquifer thickness is equivalent to the screened interval. The geometric mean hydraulic conductivity value of 767 ft/day was used for simulating the base case aquifer conditions. The effective porosity is 0.3, which is the default value presented in Table F-3 of the Idaho Wellhead Protection Plan for unconsolidated alluvium (IDEQ, 1997, p. F-6). Base elevation of the aquifer is 5,799 ft msl (bottom of Well #1 screen), and the aquifer thickness is 65 feet. The pumping rates are 1.5 times the indicated average on the owner/operator response to the PWS questionnaire (WGINT, 2000a). The areal recharge is 1 in./yr, based on an infiltration test conducted at the Idaho National Engineering and Environmental Laboratory by

Cecil et al. (1992) that resulted in an infiltration rate of 0.4 in./yr. A higher infiltration rate was used because Mackay is located at a higher elevation and in an area with more precipitation and less evapotranspiration. A constant-head boundary was used to simulate the Big Lost River. Aquifer recharge along the bedrock/valley-fill contact was simulated using a constant-flux line sink backed by a no-flow boundary.

The final hybrid capture zones fill the valley located north of the PWS wells to Mackay Reservoir between the Big Lost River on the west and the Lost River Range on the east. Hybrid capture zone boundaries are terminated on the east where they intersect the 6,000-foot contour and on the west at the Big Lost River. Each of the resulting 4.3-mile-long capture zones encompasses an approximate area of 2 square miles (1.4 square miles for the 0- to 3-yr travel times and 0.6 square mile for the 3- to 6-yr travel times).

Springs and Spring Delineation Methods

A spring is defined as a concentrated discharge of ground water appearing at the ground surface as flowing water (Todd, 1980). The discharge of a spring depends on the hydraulic conductivity of the aquifer, the area of contributing recharge to the aquifer, and the rate of aquifer recharge. PWS springs are generally perennial. Large seasonal changes in the discharge rates are an indication of a relatively shallow flow system. While most springs fluctuate in their rate of discharge, springs in volcanic rock (e.g., basalt) are noted for their nearly constant discharge (Todd, 1980).

Delineation of the drinking water protection area for a spring involves special consideration. Hydrogeologic setting is foremost among the factors that control the shape and extent of the capture zone. A spring resulting from the presence of a high permeability fracture extending to great depth will have a much different capture zone than a depression spring formed where the ground surface intersects the water table in an unconsolidated aquifer. The calculated fixed radius method was used to delineate the Mackay spring.

The delineated source water assessment areas for the City of Mackay wells can best be described as northwestward trending corridors nearly four miles long and nearly a mile wide, following Highway 93 and the Big Lost River. The delineations end at the reservoir and only include a 3-year and a 6-year TOT zone (Figure 2 and Figure 3 in Appendix A). The delineated area for the City Spring is three concentric circles that cover an area of 20 acres for the 3-year TOT zone, 23 acres for the 6-year TOT zone, and 35 acres for the 10-year TOT zone (Figure 4 in Appendix A). The actual data used by WGI in determining the source water assessment delineation areas are available from DEQ upon request.

Identifying Potential Sources of Contamination

A potential source of contamination is defined as any facility or activity that stores, uses, or produces, as a product or by-product, the contaminants regulated under the Safe Drinking Water Act and others, such as *cryptosporidium*, and has a sufficient likelihood of releasing such contaminants at levels that could pose a concern relative to drinking water sources. The goal of the inventory process is to locate and describe those facilities, land uses, and environmental conditions that are potential sources of groundwater contamination. The locations of potential sources of contamination within the delineation areas were obtained by field surveys conducted by DEQ and from available databases.

Land use within the immediate area of the City of Mackay wells consists of residential land use and irrigated agriculture, while the surrounding area is predominantly rangeland. Land use within the immediate area and the surrounding area of the City Spring is predominantly rangeland.

It is important to understand that a release may never occur from a potential source of contamination provided they are using best management practices. Many potential sources of contamination are regulated at the federal level, state level, or both to reduce the risk of release. Therefore, when a business, facility, or property is identified as a potential contaminant source, this should not be interpreted to mean that this business, facility, or property is in violation of any local, state, or federal environmental law or regulation. What it does mean is that the potential for contamination exists due to the nature of the business, industry, or operation. There are a number of methods that water systems can use to work cooperatively with potential sources of contamination, including educational visits and inspections of stored materials. Many owners of such facilities may not even be aware that they are located near a public water supply well.

Contaminant Source Inventory Process

A two-phased contaminant inventory of the study area was conducted from July through August 2001. The first phase involved identifying and documenting potential contaminant sources within the City of Mackay source water assessment areas (Figure 2, Figure 3, and Figure 4 in Appendix A) through the use of sanitary surveys, computer databases, and Geographic Information System (GIS) maps developed by DEQ. The second, or enhanced, phase of the contaminant inventory involved contacting the operator to identify and add any additional potential sources in the area.

The delineated source water areas of the wells encompass northwestward trending corridors of land between the well sites and the Mackay Reservoir. Both well delineations include Highway 93 and the Big Lost River. Additionally, according to the 1996 sanitary survey, sewer lines lie within 200 feet of Well #1 (Table 2, Figure 2, Appendix A). The enhanced phase of the contaminant inventory identified several potential contaminant sources within the Well #2 delineation (Table 3, Figure 3, Appendix A). These sources all exist within the 3-year TOT zone and include two motels, an auto repair shop, a highway district, and electric company, a forest service office and warehouse, a market, and an ATC telephone.

The delineated source water area of the City Spring encompasses a circular area of approximately 78 acres total between Taylor Canyon and the Rio Grande Canyon southwest of the City of Mackay. The delineation only includes one unimproved road as a potential contaminant source. This road runs through the 3-year, 6-year, and 10-year TOT zones and could contribute contaminants to the aquifer in the event of an accidental spill, release, or flood (Table 4, Figure 4, Appendix A).

Section 3. Susceptibility Analyses

Each well's susceptibility to contamination was ranked as high, moderate, or low risk according to the following considerations: hydrologic characteristics, physical integrity of the well, land use characteristics, and potentially significant contaminant sources. Each of these categories carries the same weight in the final assessment, meaning that a low score in one category coupled with higher scores in the other categories can still lead to an overall susceptibility of high. Similarly, the spring's susceptibility to contamination was ranked as high, moderate, or low risk according to the following considerations: construction, land use characteristics, and potentially significant contaminant sources. The susceptibility rankings are specific to a particular potential contaminant or category of contaminants. Therefore, a high susceptibility rating relative to one potential contaminant does not mean that the water system is at the same risk for all other potential contaminants. The relative ranking that is derived for each well is a qualitative, screening-level step that, in many cases, uses generalized assumptions and best professional judgement. Appendix B contains the susceptibility analysis worksheets for the system. The following summaries describe the rationale for the susceptibility ranking.

Hydrologic Sensitivity

The hydrologic sensitivity of a well is dependent upon four factors: the surface soil composition, the material in the vadose zone (between the land surface and the water table), the depth to first ground water, and the presence of a 50-foot thick fine-grained zone above the producing zone of the well. Slowly draining soils such as silt and clay typically are more protective of ground water than coarse-grained soils such as sand and gravel. Similarly, fine-grained sediments in the subsurface and a water depth of more than 300 feet protect the ground water from contamination.

Hydrologic sensitivity rates moderate for both wells (Table 1). The soils underlying the majority of the delineated area are in the poor to moderately-draining soil class, reducing the downward movement of contaminants to the aquifer. Both well logs show that the vadose zone is composed predominantly of a mixture of gravel, sand, and some mixed clay. The static water table is found at 16.5 feet below ground surface (bgs) for Well #1 and at 18 feet bgs for Well #2. First ground water for Well #1 is between 105 and 114 feet bgs and first ground water for Well #2 is between 54 and 100 feet bgs.

Well Construction

Well construction directly affects the ability of the well to protect the aquifer from contaminants. System construction scores are reduced when information shows that potential contaminants will have a more difficult time reaching the intake of the well. Lower scores imply a system is less vulnerable to contamination. For example, if the well casing and annular seal both extend into a low permeability unit, then the possibility of contamination is reduced and the system construction score goes down. If the highest production interval is more than 100 feet below the water table, then the system is considered to have better buffering capacity. If the wellhead and surface seal are maintained to standards, as outlined in sanitary surveys, then contamination down the well bore is less likely. If the well is protected from surface flooding and is outside the 100-year floodplain, then contamination from surface events is reduced.

The City of Mackay wells have moderate system construction scores. According to the 1996 sanitary survey, the wellhead and surface seals are maintained and both wells are properly protected from surface flooding. The well logs provided some useful well construction information.

Well #1 was drilled in 1973 to a depth of 114 feet bgs. It has a 0.250-inch thick, 12-inch diameter casing set to a depth of 105 feet bgs into “clay and gravel.” The well is sealed to 20 feet bgs into “sand and gravel.” Well #2 was drilled in 1990 to a depth of 100 feet bgs. It has a 0.250-inch thick, 10-inch diameter casing set to a depth of 100 feet bgs into “sand, gravel, and brown clay.” The well is sealed to 20 feet into “sand and gravel” and the casing is perforated from 38 to 98 feet bgs.

Though the wells may have been in compliance with standards when they were completed, current public water system (PWS) well construction standards are more stringent. The Idaho Department of Water Resources *Well Construction Standards Rules* (1993) require all PWSs to follow DEQ standards as well. IDAPA 58.01.08.550 requires that PWSs follow the *Recommended Standards for Water Works* (1997) during construction. These standards include provisions for well screens, pumping tests, and casing thicknesses to name a few. Table 1 of the *Recommended Standards for Water Works* (1997) lists the required steel casing thickness for various diameter wells. A ten-inch diameter well requires a casing thickness of at least 0.365-inches and a twelve-inch diameter well requires a casing thickness of at least 0.375-inches. As such, the wells were assessed an additional point for system construction.

Spring Construction

Spring construction scores are determined by evaluating whether the spring has been constructed according to Idaho Code (IDAPA 58.01.08.04) and if the spring's water is exposed to any potential contaminants from the time it exits the bedrock to when it enters the distribution system. If the spring's intake structure, infiltration gallery, and housing are located and constructed in such a manner as to be permanent and protect it from all potential contaminants, is contained within a fenced area of at least 100 feet in radius, and is protected from all surface water by diversions, berms, etc., then Idaho Code is being met and the score will be lower. If the spring's water comes in contact with the open atmosphere before it enters the distribution system, it receives a higher score. Likewise, if the spring's water is piped directly from the bedrock to the distribution system or is collected in a protected spring box without any contact to potential surface-related contaminants, the score is lower.

The City Spring was developed in 1902 and redeveloped in 1995. The spring water flows from a rock formation that is enclosed in a concrete structure. The structure has a locked access hatch, screened vent, drain pipe and a 10-inch discharge line that delivers water to a 300,000-gallon concrete reservoir located approximately one-fourth mile downgradient of the spring.

The spring rated moderate for system construction (Table 1). Positively affecting the score is the fact that water destined for the distribution system is collected from underground and enters the distribution system without contacting the atmosphere. However, it is unknown if the area within 100 feet of the spring is fenced or if the surface water or runoff water is diverted above the spring to avoid contamination. The area within 50 feet of the spring is fenced. Although the city does not own this property, the City of Mackay has exclusive legal control of the land within 50 feet of the spring.

Potential Contaminant Source and Land Use

Well #1 of the City of Mackay rates moderate for IOCs (e.g. nitrates arsenic), VOCs (e.g. petroleum products), SOCs (e.g. pesticides), and microbial contaminants (e.g. bacteria). Well #2 rates high for IOCs and SOCs and it rates moderate for VOCs and microbial contaminants. The City Spring rates low for all potential contaminants due to the limited number of contaminants that surround the spring area. The intense agricultural land use around the wellheads accounts for the largest contribution of points to the potential contaminant inventory rating. The delineated area of Well #2 contains a greater number of potential contaminant sources, increasing the land use rating for that well.

Final Susceptibility Rankings

A detection above a drinking water standard MCL, any detection of a VOC or SOC, or a confirmed microbial detection at the wellhead or the spring will automatically give a high susceptibility rating to the well or the spring, despite the land use of the area, because a pathway for contamination already exists. Additionally, if there are contaminant sources located within 50 feet of the wellhead or 100 feet of the spring source then the drinking water source will automatically get a high susceptibility rating. Hydrologic sensitivity and system construction scores are heavily weighted in the final scores. Having multiple potential contaminant sources in the 0- to 3-year time of travel zone (Zone 1B) and agricultural land contribute greatly to the overall ranking. In terms of total susceptibility, the City of Mackay wells both rate moderate susceptibility to IOCs, VOCs, and SOCs. Well #1 rates moderate and Well #2 rates high susceptibility to microbial contaminants. The City Spring rates low susceptibility to all potential contaminant categories.

Table 1. Summary of City of Mackay Susceptibility Evaluation

Well	Susceptibility Scores[1]									
	Hydrologic Sensitivity	Contaminant Inventory				System Construction	**Final Susceptibility Ranking**			
		IOC	VOC	SOC	Microbials		IOC	VOC	SOC	Microbials
Well #1	M	M	M	M	M	M	M	M	M	M
Well #2	M	H	M	H	M	M	M	M	M	H
City Spring	---	L	L	L	L	M	L	L	L	L

[1]H = High Susceptibility, M = Moderate Susceptibility, L = Low Susceptibility,
IOC = inorganic chemical, VOC = volatile organic chemical, SOC = synthetic organic chemical

Susceptibility Summary

Overall, the wells of the City of Mackay rate moderate for IOCs, VOCs, and SOCs. Well #1 rates moderate and Well #2 rates high susceptibility to microbial contaminants. The irrigated agricultural land use in the 3-year TOT zone of the delineations contributed to the overall susceptibility of both wells. The City Spring has a low susceptibility to all potential contaminants. The greater number of potential contaminant sources combined with the moderate system construction and hydrologic sensitivity scores contributed to the high microbial contaminant score for Well #2.

There are no current significant potential water problems affecting the City of Mackay thus far. Total coliform bacteria have been detected in the well distribution system from August 1995 to July 1999. However, no coliform bacteria have detected at either of the wellheads. The IOCs barium, copper, fluoride, lead, chromium, and nitrate were detected in the system at levels below the MCLs. Arsenic was detected in Well #2 and at the spring at 5 ppb in December 1995, a level one-half of the recently revised MCL of 10 ppb. In October 2001, the EPA lowered the arsenic standard from 50 ppb to 10 ppb, giving public water systems until 2006 to comply with the new standard. EPA requires reporting to the CCR if concentrations of detected compounds are greater than half their MCL. Further information and health side-effects can be researched at http://www.epa.gov/safewater/ccr1.html. No VOCs or SOCs have been detected in the wells or the spring during any water chemistry tests.

Section 4. Options for Drinking water protection

The susceptibility assessment should be used as a basis for determining appropriate new protection measures or re-evaluating existing protection efforts. No matter what the susceptibility ranking a source receives, protection is always important. Whether the source is currently located in a "pristine" area or an area with numerous industrial and/or agricultural land uses that require surveillance, the way to ensure good water quality in the future is to act now to protect valuable water supply resources.

An effective drinking water protection program is tailored to the particular local drinking water protection area. A community with a fully developed drinking water protection program will incorporate many strategies. For the City of Mackay, drinking water protection activities should focus on correcting any deficiencies outlined in the sanitary survey. Also, disinfection practices should be implemented if microbial contamination becomes a problem. No chemicals should be stored or applied within the 50-foot radius of the wellhead and within 100-foot radius of the spring source. Additionally, there should be a focus on the implementation of practices aimed at reducing the leaching of farm chemicals from agricultural land within the designated source water areas and awareness of the potential contaminant sources within the delineation zones. Since much of the designated protection areas are outside the direct jurisdiction of the City of Mackay, collaboration and partnerships with state and local agencies, and industry groups should be established and are critical to the success of drinking water protection.

Due to the time involved with the movement of ground water, drinking water protection activities should be aimed at long-term management strategies even though these strategies may not yield results in the near term. A strong public education program should be a primary focus of any drinking water protection plan as the delineation is near to urban and residential land uses. Public education topics could include proper lawn and garden care practices, household hazardous waste disposal methods, proper care and maintenance of septic systems, and the importance of water conservation to name but a few. There are multiple resources available to help communities implement protection programs, including the Drinking Water Academy of the EPA. As there is a transportation corridor through the delineations, the Idaho department of transportation should be involved in protection activities. Drinking water protection activities for agriculture should be coordinated with the Idaho State Department of Agriculture, the Soil Conservation Commission, the Custer Soil and Water Conservation District, and the Natural Resources Conservation Service.

A community must incorporate a variety of strategies in order to develop a comprehensive source water assessment protection plan, be they regulatory in nature (e.g. zoning, permitting) or non-regulatory in nature (e.g. good housekeeping, public education, specific best management practices). For assistance in developing protection strategies please contact the Idaho Falls Regional Office of the DEQ or the Idaho Rural Water Association.

Assistance

Public water supplies and others may call the following DEQ offices with questions about this assessment and to request assistance with developing and implementing a local protection plan. In addition, draft protection plans may be submitted to the DEQ office for preliminary review and comments.

Idaho Falls Regional DEQ Office (208) 528-2650

State DEQ Office (208) 373-0502

Website: http://www.deq.state.id.us

Water suppliers serving fewer than 10,000 persons may contact Melinda Harper (mlharper@idahoruralwater.com), Idaho Rural Water Association, at 1-208-343-7001 for assistance with drinking water protection (formerly wellhead protection) strategies.

POTENTIAL CONTAMINANT INVENTORY
LIST OF ACRONYMS AND DEFINITIONS

AST (Aboveground Storage Tanks) – Sites with aboveground storage tanks.

Business Mailing List – This list contains potential contaminant sites identified through a yellow pages database search of standard industry codes (SIC).

CERCLIS – This includes sites considered for listing under the **Comprehensive Environmental Response Compensation and Liability Act (CERCLA)**. CERCLA, more commonly known as Superfund is designed to clean up hazardous waste sites that are on the national priority list (NPL).

Cyanide Site – DEQ permitted and known historical sites/facilities using cyanide.

Dairy – Sites included in the primary contaminant source inventory represent those facilities regulated by Idaho State Department of Agriculture (ISDA) and may range from a few head to several thousand head of milking cows.

Deep Injection Well – Injection wells regulated under the Idaho Department of Water Resources generally for the disposal of stormwater runoff or agricultural field drainage.

Enhanced Inventory – Enhanced inventory locations are potential contaminant source sites added by the water system. These can include new sites not captured during the primary contaminant inventory, or corrected locations for sites not properly located during the primary contaminant inventory. Enhanced inventory sites can also include miscellaneous sites added by the Idaho Department of Environmental Quality (DEQ) during the primary contaminant inventory.

Floodplain – This is a coverage of the 100year floodplains.

Group 1 Sites – These are sites that show elevated levels of contaminants and are not within the priority one areas.

Inorganic Priority Area – Priority one areas where greater than 25% of the wells/springs show constituents higher than primary standards or other health standards.

Landfill – Areas of open and closed municipal and non-municipal landfills.

LUST (Leaking Underground Storage Tank) – Potential contaminant source sites associated with leaking underground storage tanks as regulated under RCRA.

Mines and Quarries – Mines and quarries permitted through the Idaho Department of Lands.)

Nitrate Priority Area – Area where greater than 25% of wells/springs show nitrate values above 5mg/L.

NPDES (National Pollutant Discharge Elimination System) – Sites with NPDES permits. The Clean Water Act requires that any discharge of a pollutant to waters of the United States from a point source must be authorized by an NPDES permit.

Organic Priority Areas – These are any areas where greater than 25% of wells/springs show levels greater than 1% of the primary standard or other health standards.

Recharge Point – This includes active, proposed, and possible recharge sites on the Snake River Plain.

RICRIS – Site regulated under **Resource Conservation Recovery Act (RCRA)**. RCRA is commonly associated with the cradle to grave management approach for generation, storage, and disposal of hazardous wastes.

SARA Tier II (Superfund Amendments and Reauthorization Act Tier II Facilities) – These sites store certain types and amounts of hazardous materials and must be identified under the Community Right to Know Act.

Toxic Release Inventory (TRI) – The toxic release inventory list was developed as part of the Emergency Planning and Community Right to Know (Community Right to Know) Act passed in 1986. The Community Right to Know Act requires the reporting of any release of a chemical found on the TRI list.

UST (Underground Storage Tank) – Potential contaminant source sites associated with underground storage tanks regulated as regulated under RCRA.

Wastewater Land Applications Sites – These are areas where the land application of municipal or industrial wastewater is permitted by DEQ.

Wellheads – These are drinking water well locations regulated under the Safe Drinking Water Act. They are not treated as potential contaminant sources.

NOTE: Many of the potential contaminant sources were located using a geocoding program where mailing addresses are used to locate a facility. Field verification of potential contaminant sources is an important element of an enhanced inventory.

Where possible, a list of potential contaminant sites unable to be located with geocoding will be provided to water systems to determine if the potential contaminant sources are located within the source water assessment area.

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Appendix A
City of Mackay
Potential Contaminant Inventory
Figures 2, 3, and 4
Tables 2, 3, and 4

Figure 2. City of Mackay Map and Potential Contaminant Source Locations

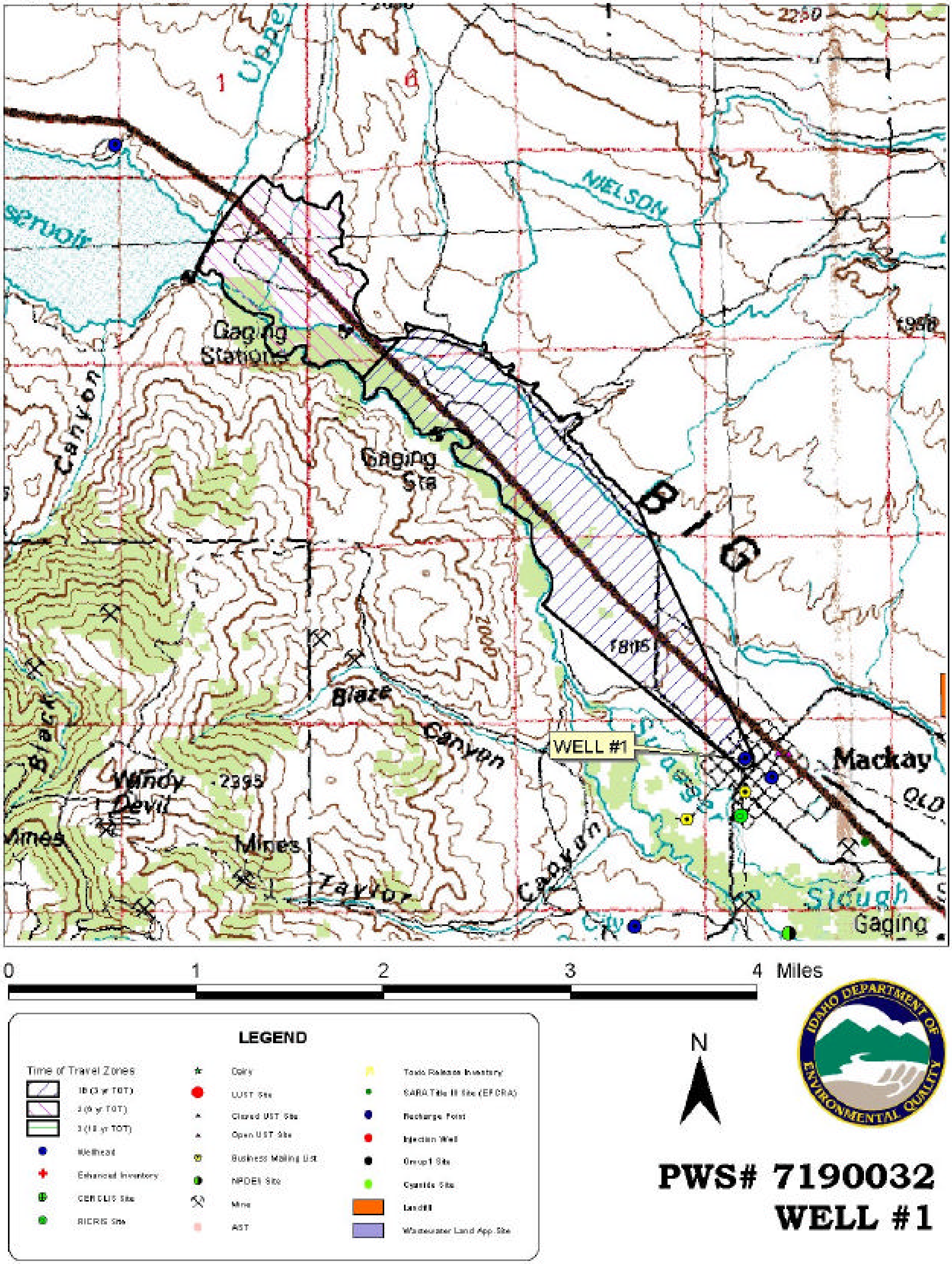

Figure 3. City of Mackay Map and Potential Contaminant Source Locations

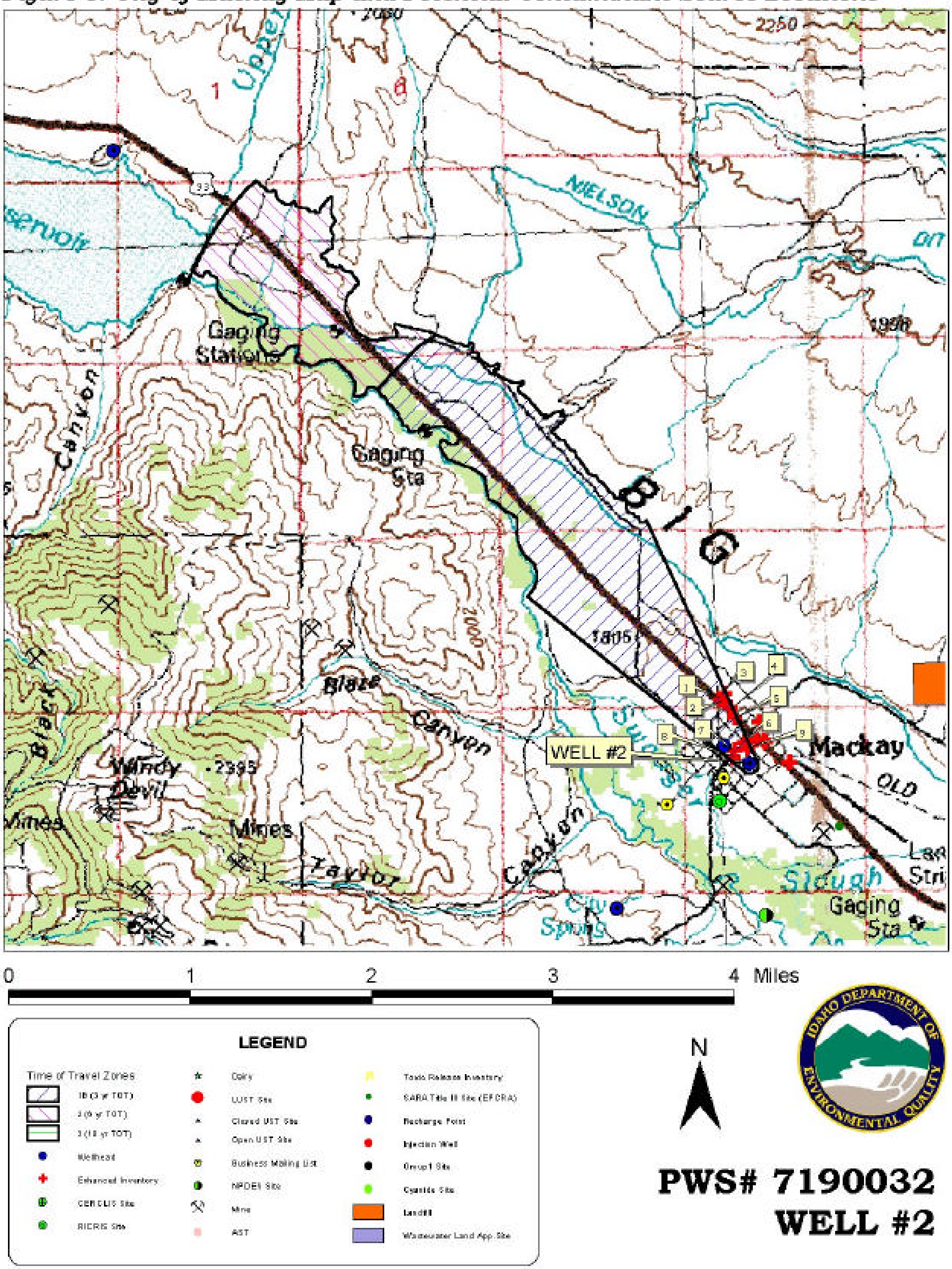

FIGURE 4. City of Mackay Delineation Map and Potential Contaminant Source Locations

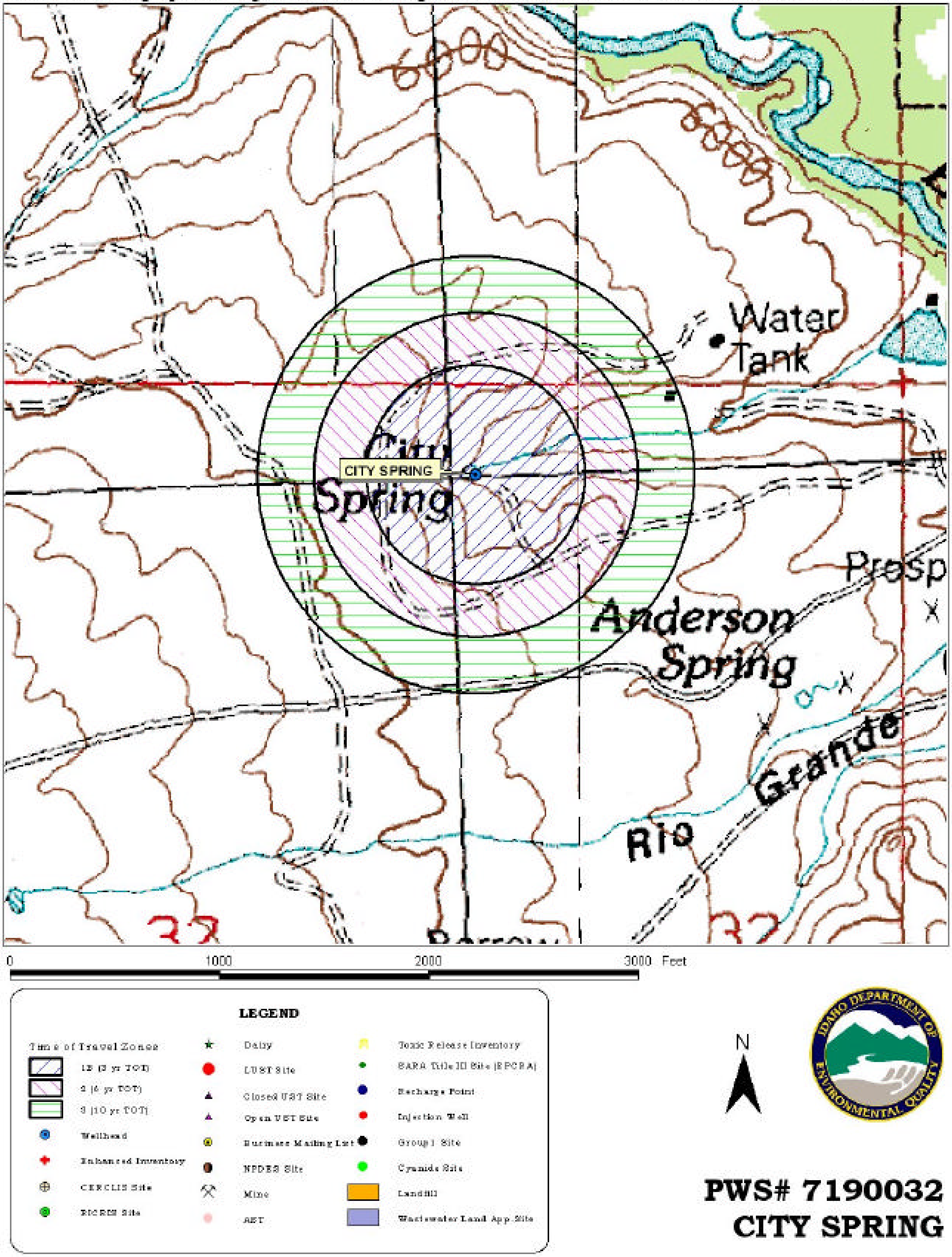

Table 2. Well #1 of the City of Mackay, Potential Contaminant Inventory

Site #	Source Description[1]	TOT ZONE[2]	Source of Information	Potential Contaminants[3]
	Sewer Lines	0 – 3	Sanitary Survey	IOC, Microbes
	State Highway 93	0 – 6	GIS Map	IOC, VOC, SOC, Microbes
	Big Lost River	0 – 6	GIS Map	IOC, VOC, SOC, Microbes

[2] TOT = time-of-travel (in years) for a potential contaminant to reach the wellhead

[3] IOC = inorganic chemical, VOC = volatile organic chemical, SOC = synthetic organic chemical

Table 3. Well #2 of the City of Mackay, Potential Contaminant Inventory

Site #	Source Description[1]	TOT ZONE[2]	Source of Information	Potential Contaminants[3]
1	Forest Service	0 – 3	Enhanced Inventory	IOC, VOC, SOC
2	Wagon Wheel Motel	0 – 3	Enhanced Inventory	IOC, VOC, SOC, Microbes
3	Forest Service Warehouse	0 – 3	Enhanced Inventory	IOC, VOC, SOC
4	Mountain Valley Auto	0 – 3	Enhanced Inventory	IOC, VOC, SOC
5	Lost River Highway District	0 – 3	Enhanced Inventory	IOC, VOC, SOC
6	Ivie's Market	0 – 3	Enhanced Inventory	IOC, VOC, SOC
7	Bear Bottom Inn	0 – 3	Enhanced Inventory	IOC, VOC, SOC, Microbes
8	ATC Telephone	0 – 3	Enhanced Inventory	IOC
9	Lost River Electric	0 – 3	Enhanced Inventory	IOC, VOC
	Highway 93	0 – 6	GIS Map	IOC, VOC, SOC, Microbes
	Big Lost River	0 – 6	GIS Map	IOC, VOC, SOC, Microbes

[2] TOT = time-of-travel (in years) for a potential contaminant to reach the wellhead

[3] IOC = inorganic chemical, VOC = volatile organic chemical, SOC = synthetic organic chemical

Table 4. City Spring of the City of Mackay, Potential Contaminant Inventory

Site #	Source Description[1]	TOT ZONE[2]	Source of Information	Potential Contaminants[3]
	Unimproved Road	0 – 10	GIS Map	IOC, VOC, SOC, Microbes

[2] TOT = time-of-travel (in years) for a potential contaminant to reach the wellhead

[3] IOC = inorganic chemical, VOC = volatile organic chemical, SOC = synthetic organic chemical

Appendix B

City of Mackay Susceptibility Analysis Worksheets

Susceptibility Analysis Formulas

Formula for Well Sources

The final scores for the susceptibility analysis were determined using the following formulas:

1. VOC/SOC/IOC Final Score = Hydrologic Sensitivity + System Construction + (Potential Contaminant/Land Use x 0.2)

2. Microbial Final Score = Hydrologic Sensitivity + System Construction + (Potential Contaminant/Land Use x 0.375)

Final Susceptibility Scoring:

0 - 5 Low Susceptibility

6 - 12 Moderate Susceptibility

≥ 13 High Susceptibility

Formula for Spring Sources

The final spring scores for the susceptibility analysis were determined using the following formulas:

1. VOC/SOC/IOC/ Final Score = (Potential Contaminant/Land Use X 0.818) + System Construction

2. Microbial Final Score = (Potential Contaminant/Land Use X 1.125) + System Construction

Final Susceptibility Scoring:

0 - 7 Low Susceptibility

8 - 15 Moderate Susceptibility

≥ 16 High Susceptibility

1. System Construction		SCORE
Drill Date	12/15/73	
Driller Log Available	YES	
Sanitary Survey (if yes, indicate date of last survey)	YES	1996
Well meets IDWR construction standards	NO	1
Wellhead and surface seal maintained	YES	0
Casing and annular seal extend to low permeability unit	NO	2
Highest production 100 feet below static water level	NO	1
Well located outside the 100 year flood plain	YES	0
	Total System Construction Score	4

2. Hydrologic Sensitivity		
Soils are poorly to moderately drained	YES	0
Vadose zone composed of gravel, fractured rock or unknown	YES	1
Depth to first water > 300 feet	NO	1
Aquitard present with > 50 feet cumulative thickness	NO	2
	Total Hydrologic Score	4

3. Potential Contaminant / Land Use - ZONE 1A		IOC Score	VOC Score	SOC Score	Microbial Score
Land Use Zone 1A	IRRIGATED CROPLAND	2	2	2	2
Farm chemical use high	NO	0	0	0	
IOC, VOC, SOC, or Microbial sources in Zone 1A	NO	NO	NO	NO	NO
Total Potential Contaminant Source/Land Use Score - Zone 1A		2	2	2	2
Potential Contaminant / Land Use - ZONE 1B					
Contaminant sources present (Number of Sources)	YES	3	2	2	3
(Score = # Sources X 2) 8 Points Maximum		6	4	4	6
Sources of Class II or III leacheable contaminants or	YES	7	2	2	
4 Points Maximum		4	2	2	
Zone 1B contains or intercepts a Group 1 Area	NO	0	0	0	0
Land use Zone 1B	Greater Than 50% Irrigated Agricultural Land	4	4	4	4
Total Potential Contaminant Source / Land Use Score - Zone 1B		14	10	10	10
Potential Contaminant / Land Use - ZONE II					
Contaminant Sources Present	YES	2	2	2	
Sources of Class II or III leacheable contaminants or	YES	1	1	1	
Land Use Zone II	25 to 50% Irrigated Agricultural Land	1	1	1	
Potential Contaminant Source / Land Use Score - Zone II		4	4	4	0
Potential Contaminant / Land Use - ZONE III					
Contaminant Source Present	NO	0	0	0	
Sources of Class II or III leacheable contaminants or	NO	0	0	0	
Is there irrigated agricultural lands that occupy > 50% of	NO	0	0	0	
Total Potential Contaminant Source / Land Use Score - Zone III		0	0	0	0
Cumulative Potential Contaminant / Land Use Score		20	16	16	12

4. Final Susceptibility Source Score	12	11	11	12
5. Final Well Ranking	Moderate	Moderate	Moderate	Moderate

Ground Water Susceptibility Report   Public Water System Name : MACKAY CITY OF   Well# : WELL #2

Public Water System Number 7190032   4/8/02 1:55:25 PM

1. System Construction		SCORE
Drill Date	7/26/90	
Driller Log Available	YES	
Sanitary Survey (if yes, indicate date of last survey)	YES	1996
Well meets IDWR construction standards	NO	1
Wellhead and surface seal maintained	YES	0
Casing and annular seal extend to low permeability unit	NO	2
Highest production 100 feet below static water level	NO	1
Well located outside the 100 year flood plain	YES	0
Total System Construction Score		4

2. Hydrologic Sensitivity		
Soils are poorly to moderately drained	YES	0
Vadose zone composed of gravel, fractured rock or unknown	YES	1
Depth to first water > 300 feet	NO	1
Aquitard present with > 50 feet cumulative thickness	NO	2
Total Hydrologic Score		4

3. Potential Contaminant / Land Use - ZONE 1A		IOC Score	VOC Score	SOC Score	Microbial Score
Land Use Zone 1A	IRRIGATED CROPLAND	2	2	2	2
Farm chemical use high	NO	0	0	0	
IOC, VOC, SOC, or Microbial sources in Zone 1A	NO	NO	NO	NO	NO
Total Potential Contaminant Source/Land Use Score - Zone 1A		2	2	2	2
Potential Contaminant / Land Use - ZONE 1B					
Contaminant sources present (Number of Sources)	YES	11	10	9	4
(Score = # Sources X 2) 8 Points Maximum		8	8	8	8
Sources of Class II or III leacheable contaminants or	YES	7	2	3	
4 Points Maximum		4	2	3	
Zone 1B contains or intercepts a Group 1 Area	NO	0	0	0	0
Land use Zone 1B	Greater Than 50% Irrigated Agricultural Land	4	4	4	4
Total Potential Contaminant Source / Land Use Score - Zone 1B		16	14	15	12
Potential Contaminant / Land Use - ZONE II					
Contaminant Sources Present	YES	2	2	2	
Sources of Class II or III leacheable contaminants or	YES	1	1	1	
Land Use Zone II	25 to 50% Irrigated Agricultural Land	1	1	1	
Potential Contaminant Source / Land Use Score - Zone II		4	4	4	0
Potential Contaminant / Land Use - ZONE III					
Contaminant Source Present	NO	0	0	0	
Sources of Class II or III leacheable contaminants or	NO	0	0	0	
Is there irrigated agricultural lands that occupy > 50% of	NO	0	0	0	
Total Potential Contaminant Source / Land Use Score - Zone III		0	0	0	0
Cumulative Potential Contaminant / Land Use Score		22	20	21	14

4. Final Susceptibility Source Score	12	12	12	13
5. Final Well Ranking	Moderate	Moderate	Moderate	High

Spring Water Susceptibility Report — Public Water System Name : MACKAY CITY OF — Spring# : CITY SPRING
Public Water System Number 7190032 — 12/18/02 12:54:55 PM

1. System Construction

		SCORE
Intake structure properly constructed	NO	1
Is the water first collected from an underground source	YES	0

Yes = spring developed to collect water from beneath the ground; lower score
No = water collected after it contacts the atmosphere or unknown; higher score

Total System Construction Score 1

2. Potential Contaminant / Land Use - ZONE 1A

		IOC Score	VOC Score	SOC Score	Microbial Score
Land Use Zone 1A	RANGELAND, WOODLAND, BASALT	0	0	0	0
Farm chemical use high	NO	0	0	0	
IOC, VOC, SOC, or Microbial sources in Zone 1A	NO	NO	NO	NO	NO
Total Potential Contaminant Source/Land Use Score - Zone 1A		0	0	0	0

Potential Contaminant / Land Use - ZONE 1B

		IOC Score	VOC Score	SOC Score	Microbial Score
Contaminant sources present (Number of Sources)	YES	1	1	1	1
(Score = # Sources X 2) 8 Points Maximum		2	2	2	2
Sources of Class II or III leacheable contaminants or	YES	1	1	1	
4 Points Maximum		1	1	1	
Zone 1B contains or intercepts a Group 1 Area	NO	0	0	0	0
Land use Zone 1B	Less Than 25% Agricultural Land	0	0	0	0
Total Potential Contaminant Source / Land Use Score - Zone 1B		3	3	3	2

Potential Contaminant / Land Use - ZONE II

		IOC Score	VOC Score	SOC Score	Microbial Score
Contaminant Sources Present	YES	2	2	2	
Sources of Class II or III leacheable contaminants or	YES	1	1	1	
Land Use Zone II	Less than 25% Agricultural Land	0	0	0	
Potential Contaminant Source / Land Use Score - Zone II		3	3	3	0

Potential Contaminant / Land Use - ZONE III

		IOC Score	VOC Score	SOC Score	Microbial Score
Contaminant Source Present	YES	1	1	1	
Sources of Class II or III leacheable contaminants or	YES	1	1	1	
Is there irrigated agricultural lands that occupy > 50% of	NO	0	0	0	
Total Potential Contaminant Source / Land Use Score - Zone III		2	2	2	0

	IOC Score	VOC Score	SOC Score	Microbial Score
Cumulative Potential Contaminant / Land Use Score	8	8	8	2
4. Final Susceptibility Source Score	6	6	6	2
5. Final Well Ranking	Low	Low	Low	Low